

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for depositing a release agent on a surface of a workpiece, comprising steps for:
 - providing a workpiece having a desired feature to be coated with a suitable release agent;
 - providing a solution comprising the mold release agent and water, wherein the workpiece can be placed within said solution; and
 - providing ultrasonic energy to the solution, said workpiece being exposed to said energy at a suitable power level and for a suitable time to provide the feature with a film containing the release agent.
2. The method of Claim 1, wherein the workpiece feature comprises a metal oxide.
3. The method of Claim 2, wherein the metal oxide is selected from the group consisting of TiO_2 , TiO , Ti_2O_3 , Ti_3O_5 , SnO , SnO_2 , Al_2O_3 , Al_2O , AlO , Ta_2O_5 , ZrO_2 , HfO_2 , Y_2O_3 , Nb_2O_4 , Nb_2O_5 , NiO , MgO , MgO_2 , Fe_2O_3 , Fe_3O_4 , FeOOH , $\text{Fe}(\text{OH})_2$, Cr_2O_3 , CrO_2 , and CrO_3 , or any combination thereof.
4. The method of Claim 3, wherein the metal oxide is Al_2O_3 .
5. The method of Claim 3, wherein the metal oxide is NiO .
6. The method of Claim 3, wherein the metal oxide is MgO .
7. The method of Claim 3, wherein the metal oxide is SnO_2 .
8. The method of Claim 1, wherein the workpiece comprises aluminum.
9. The method Claim 8, wherein the workpiece comprises once-anodized aluminum.

10. The method of Claim 1, wherein the workpiece comprises a metal oxide coating.

11. The method of Claim 10, wherein the coating exhibits an isoelectric point greater than about 2.

12. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 4.

13. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 8.

14. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 10.

15. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point less than or about equal to 12.

16. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point from about 7 to about 12.5.

17. The method of Claim 16, wherein the metal oxide is selected from the group consisting of Fe_2O_3 , Fe_3O_4 , FeOOH , and $\text{Fe}(\text{OH})_2$, or any combination thereof.

18. The method of Claim 10, wherein the metal oxide exhibits an isoelectric point from about 6 to about 7.

19. The method of Claim 18, wherein the metal oxide is selected from the group consisting of CrO_3 , CrO_2 , and Cr_2O_3 , or any combination thereof.

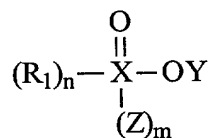
20. The method of Claim 1, wherein the solution comprises water, alcohol and a release agent.

21. The method of Claim 20, wherein the release agent comprises up to 1% of the solution.

22. The method of Claim 1, wherein the release agent is an anionic compound.

23. The method of Claim 1, wherein the release agent comprises fluorine.

24. The method of Claim 1, wherein the release agent is a compound with the following general formula:



wherein,

Y is any element or combination of elements that forms an acid conjugate upon dissociation,

X is any element that facilitates the dissociation and formation of a base conjugate with reduced chemical interaction with the resin mixture,

R₁ is any combination of elements that provides a non-reactive barrier film on the workpiece surface,

n is either 1 or 2,

Z is either O or OH,

m is either 0 or 1.

25. The method of Claim 24, wherein,

Y is H, NH₄, or NR₄, wherein R is any aliphatic hydrocarbon chain,

X is P, S, or C,

R₁ is any alkyl, alkyl ester, or fluorinated alkyl esters, R₁ having from 8 to 20 carbon units,

n is 1 when X is C or S or when X is P and the compound describes phosphonic acid or di-acid phosphate esters, n is 2 when X is P and the compound describes phosphinic acid or mono-acid phosphate esters,

Z is O when X is S and the compound describes sulfonic acids, Z is OH when X is P and the compound describes di-acid phosphate esters or phosphonic acids, and m is 1,

m is 0 when X is C or X is P and the compound describes mono-acid phosphates or phosphinic acid.

26. The method of Claim 1, wherein the release agent is an ester or acid selected from the group consisting of phosphates, phosphonates, phosphonites, sulfates, sulfites and carboxylates.

27. The method of Claim 1, wherein the frequency of ultrasonic energy is up to about 40 kHz.

28. The method of Claim 1, wherein the source of ultrasonic energy is provided either internally or externally to the solution.

29. The method of Claim 1, wherein the source of ultrasonic energy is rastered over the workpiece.

30. The method of Claim 1, further comprising a step for drying the workpiece, comprising subjecting the workpiece to a temperature of about 80 to about 120 degrees centigrade for a time period up to about 4 hours.

31. The method of Claim 1, further comprising a step for:
providing a transport gas into the solution.

32. The method of Claim 31, wherein the gas is selected from the group consisting of air, nitrogen, oxygen, argon, CF₄, alkanes or any combination thereof.

33. A mold made by the method of Claim 1.

34. A method for making a thermoset molded body, comprising steps for:
providing a workpiece having an ultrasonically applied release agent at a mold feature;

providing a suitable thermoset resin in contact with the mold feature;
curing the resin to form a molded body; and
separating the molded body from the workpiece.

35. The method of Claim 34, wherein the workpiece comprises a metal oxide.

36. The method of Claim 35, wherein the metal oxide is selected from the group consisting of TiO_2 , TiO , Ti_2O_3 , Ti_3O_5 , SnO , SnO_2 , Al_2O_3 , Al_2O , AlO , Ta_2O_5 , ZrO_2 , HfO_2 , Y_2O_3 , Nb_2O_4 , Nb_2O_5 , NiO , MgO , MgO_2 , Fe_2O_3 , Fe_3O_4 , FeOOH , $\text{Fe}(\text{OH})_2$, Cr_2O_3 , CrO_2 , and CrO_3 , or any combination thereof.

37. The method of Claim 35, wherein the metal oxide is Al_2O_3 .

38. The method of Claim 35, wherein the metal oxide is NiO .

39. The method of Claim 35, wherein the metal oxide is MgO .

40. The method of Claim 35, wherein the metal oxide is SnO_2 .

41. The method of Claim 34, wherein the workpiece comprises aluminum.

42. The method of Claim 41, wherein the workpiece comprises once-anodized aluminum.

43. The method of Claim 34, wherein the workpiece comprises a metal oxide coating.

44. The method of Claim 43, wherein the coating exhibits an isoelectric point greater than about 2.

45. The method of Claim 43, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 4.

46. The method of Claim 43, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 8.

47. The method of Claim 43, wherein the metal oxide exhibits an isoelectric point greater than or about equal to 10.

48. The method of Claim 43, wherein the metal oxide exhibits an isoelectric point less than or about equal to 12.

49. The method of Claim 43, wherein the metal oxide exhibits an isoelectric point from about 7 to about 12.5.

50. The method of Claim 34, wherein the resin mixture comprises an epoxy or an isocyanate urethane precursor.

51. The method of Claim 50, wherein the resin mixture comprises a compound selected from the group consisting of isophorone diisocyanate, 1,6-hexamethylene diisocyanate, xylylene diisocyanate, bis(4-isocyanatocyclohexyl) methane, cyclohexane diisocyanates, toluene diisocyanate, tetramethylxylyene diisocyanate methylene, bis(cyclohexyl isocyanate), bis 3,4 epoxy cyclohexyl methyl adipate, 3,4 epoxy cyclohexyl methyl - 3-cyclohexyl methyl adipate and diallyl diglycol carbonate.

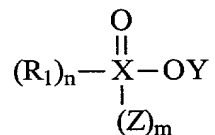
52. The method of Claim 34, wherein the solution comprises water, alcohol and a release agent.

53. The method of Claim 52, wherein the release agent comprises up to 1% of the solution.

54. The method of Claim 34, wherein the release agent is an anionic compound.

55. The method of Claim 34, wherein the release agent comprises fluorine.

56. The method of Claim 34, wherein the release agent is a compound with the following general formula:



wherein,

Y is any element or combination of elements that forms an acid conjugate upon dissociation,

X is any element that facilitates the dissociation and formation of a base conjugate with reduced chemical interaction with the resin mixture,

R₁ is any combination of elements that provides a non-reactive barrier film on the workpiece surface,

n is either 1 or 2,

Z is either O or OH,

m is either 0 or 1.

57. The method of Claim 56, wherein,

Y is H, NH₄, or NR₄, wherein R is any aliphatic hydrocarbon chain,

X is P, S, or C,

R₁ is any alkyl, alkyl ester, or fluorinated alkyl esters, R₁ having from 8 to 20 carbon units,

n is 1 when X is C or S or when X is P and the compound describes phosphonic acid or di-acid phosphate esters, n is 2 when X is P and the compound describes phosphinic acid or mono-acid phosphate esters,

Z is O when X is S and the compound describes sulfonic acids, Z is OH when X is P and the compound describes di-acid phosphate esters or phosphonic acids, and m is 1,

m is 0 when X is C or X is P and the compound describes mono-acid phosphates or phosphinic acid.

58. The method of Claim 34, wherein the release agent is an ester or acid selected from the group consisting of phosphates, phosphonates, phosphonites, sulfates, sulfites and carboxylates.

59. A molded body made by the method of Claim 34.

60. A system for making molded bodies, comprising:
a once-anodized aluminum workpiece;
a solution comprising a suitable release agent wherein the workpiece can be suitably placed in said solution; and
an ultrasonic tool located in a suitable relationship to the workpiece to deliver ultrasonic energy to the workpiece when the workpiece is placed in the solution.

61. A mold for making molded bodies, comprising:
a suitable mold feature, and
an ultrasonically-applied release agent on said mold feature.

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